PUBLIC UNDERSTANDING TOWARDS SUSTAINABLE CLOTHING AND THE SUPPLY CHAIN

Vaeovan Saicheua*, Tim Cooper, Alistair Knox*****
Nottingham Trent University
*N0350098@ntu.ac.uk
**T.H.Cooper@ntu.ac.uk
***Alistair.Knox@ntu.ac.uk

KEYWORDS

Clothing, Sustainability, Supply Chain, Green-Fashion, Ethical-Fashion, Eco-Fashion

ABSTRACT

The evident contradiction between fashion culture and sustainability raises critical issues for the clothing industry and public understanding will be important if strategies to help the industry evolve in a more sustainable direction are to succeed. This paper reports on the early stages of research into a more sustainable supply chain development model. The research aims to discover the problems affecting sustainability that currently exist in the fashion supply chain by considering different points of view from representatives of consumers and clothing industry experts. Areas to be addressed include green manufacturing, organic garments, the reusing or recycling of used and unwanted clothes, and the market for second hand clothes.

This paper utilises findings from a consumer questionnaire and interviews with consumers and industry representatives to explore public awareness and understanding of sustainable clothing and recent industry initiatives. The consumer research confirmed that while some consumers are informed and aware of the issues, others show little interest in sustainability aspects of fashion. The industry research indicated the potential for promoting sustainability in the fashion supply chain, but found that little communication has been made to consumers.

Further research will be undertaken to explore how the fashion industry can develop a sustainable business model in the light of public behaviour and market conditions.

INTRODUCTION

This paper is a preliminary report on the development of a sustainable supply chain model that aims to promote sustainability in UK mainstream fashion retailers and demote the cheap disposable clothing culture. Such a model broadly aims to cover the three dimensions of strategy: economic, social and environmental (1). The goal of this model is to enable the mainstream fashion supply chain to continue making its long term profit in a highly competitive market while being socially and environmentally responsible (2). It is important that the model aims to cover the sustainability of fashion supply chain throughout the clothing life cycle, from upstream sourcing of raw materials through to end-of-life disposal.

Within the clothing and textile industry, issues have been raised in several environmental and ethical areas throughout the supply chain. The scope starts from the excessive use of land (3), water and pesticides in growing natural fibres, especially cotton (4); then extends to excessive water and chemicals used and discharged from fabric production, particularly the textile dyeing and finishing process (5). Research has also shown that the clothing usage process, in particular laundering and tumble drying, is more energy intensive than production processes (6). Furthermore, the deflation of garment prices since the 1990s of clothing imported from developing countries (7) has raised the issue of unfair labour sourcing in overseas clothing suppliers and manufacturers (8). This deflation has increased the overall carbon footprint as a result of import logistics (9) and created cheap a disposable clothing culture that generates more waste, much of which ends up in landfill (10). Such problems have created a growing interest in this subject.

Globally, there has been the development of many textile standards to promote production that meets social and environmental requirements (11). By 2007, the UK Department of Environment Food and Rural Affairs (Defra) had launched a sustainable clothing roadmap, which aims to provide guidelines to improve performance across the clothing supply chain from design through to end-of-life management (12). Meanwhile industry has been developing international third-party standards and indices to ensure that the supply chain is more transparent and easier to monitor by stakeholders (13).

However, there is a need for further investigation of the sustainability of complex clothing supply chains in what is considered a ‘demand pull’ industry (14). Change will occur only if the majority of retailers and consumers are willing to integrate sustainability into their businesses or their purchases (15). Thus, the purpose of this paper is to use a study of downstream end of the supply chain, adopting a grounded theory approach (16) to develop an alternative business model for the way forward.

The next section of the paper will explore current knowledge of issues relating to sustainability in fashion supply chains and, in particular, consumer awareness. This is followed by the research methodology. Initial findings, an insight into on-going developments in the industry and current difficulties in tackling the environmental and ethical problems are then described. Finally, the implications for consumers and industry experts and the next phase of the research are summarised.

LITERATURE REVIEW

This section will use secondary research to illustrate how the fashion industry is currently considered ethically compromised and environmentally unsustainable and discuss public awareness of sustainability issues in the fashion supply chain.

Clothing Supply Chain Unsustainability

It is necessary to consider the overall scope of sustainability issues and criticisms raised throughout the clothing industry. Sustainability study requires a broad scope to make sure that problems are lessened throughout, not to reduce one problem while creating another. Thus the scope stretches from fibre production (natural/synthetic), knitting and weaving, dyeing and finishing, garment manufacturing, global transportation, retailing and the usage phase, through to end-of-life disposal.

Raw Materials Impacts

The most commonly used fibres, dominating 80% of the global market, are cotton (natural) and polyester (synthetic) (17). These two major fibres have different environmental impacts. Cotton accounts for nearly 40% of world textile demand (18). Though only 3% of the globe's farmland is used to grow cotton (2), cotton account for 16% of pesticide usage (19). To produce one kilogram of cotton lint takes an average of 5.44 g of pesticide (2) and an average of 13.5 cubic metres of water (20). Hence, it is estimated that for total cotton production from 2007 to 2010 (around 71m tons) (21), 388m kilograms of pesticide and 964 trillion cubic metres of water were used (Table 1). Pesticide use can contribute to biodiversity loss, soil erosion and chemical waste, while half of the water used in growing cotton is from irrigation (the other half being from rainfall) (22) which can have a negative impact: a prime example of excessive irrigation is thought to be the shrinking of the Aral Sea (6).

Year	Cotton production (17)	Pesticide use (2)	Water usage (18)
	in million tons	in million kgs	in trillion cubic metres
2007/2008	26.06	141.78	351.83
2008/2009	23.32	126.85	314.80
2009/2010	22.06	119.98	297.75
Total	**71.44**	**388.61**	**964.38**

Table 1: Environmental impact of growing cotton

By contrast with cotton, a "cradle to factory gate" study showed that PET (polyethylene terephthalate) polyester fibre requires less water and land to produce but has much higher impacts on CO2 emissions, living and non-living (abiotic) natural resource depletion and non-renewable energy use (23). This is because polyester production is petrochemical based, which not only uses petroleum products as a feedstock but also in generating energy for the manufacturing process (17). In addition, there has been a trend of rising cotton prices in recent years and, therefore, a trend towards the consumption of other

synthetic fibres such as other types of polyester, polypropylene, nylon and acrylic. These materials also contribute to air pollution as their production generates significant amounts of greenhouse gas and may emit harmful heavy metal substances in poorly regulated regions (24).

Processing Impacts

There are many sustainability concerns in the processing stages from fibre to fabric and garment production. Firstly, the dyeing process can be water and chemical intensive. It takes approximately 80 to 100 litres of water to dye a kilogram of fibre (5). Also, there are various chemicals discharged with water from the dye house that, if untreated, can endanger water-based biodiversity and enter the human food chain (25) In addition, two commonly used toxic chemicals in dyeing process that may cause skin cancer and allergies are formaldehyde (26) and aromatic amines from azo dyes (11). Formaldehyde has a restricted use in the EU but is not banned in import or export goods (27). Aromatic amines in textiles sold in Europe are banned by law and the new REACH legislation obliges much stricter chemical compliance generally. However, given the complexity and lack of transparency of the clothing supply chain processes outside Europe (11), this law can be difficult to implement. Furthermore, recent research has shown that it is possible for harmful chemicals banned in Europe to have residual nonyphenol ethoxylates (NEPs) embedded in imported clothes which may be released in washing and passed through to the water stream in the countries where clothes are purchased and used. NEPs break down in water treatment process to toxic nonylphenol (NPs), which acts as a hormone disruptor; it accumulates in the tissues of fish and tends to magnify through food chain (28).

Secondly, issues of excessive energy usage and unethical labour arise in the knitting, weaving and manufacturing processes. In fibre and fabric production, processes are capital or machinery intensive, which tend to rely on non-renewable energy such as fossil fuel and nuclear power. The labour-intensive garment making process, to be more cost effective in highly competitive markets, may result in labour being sourced unethically (29).

Thirdly, the western ‘fast fashion’ culture has created higher levels of transportation through importing and exporting. The turnaround time demanded by fast fashion, often less than two weeks, will involve higher carbon emissions when airfreight is used. An additional consideration is that in sea and road containers clothes are often shipped as ‘retail-ready’, hanging on bars or strings in the container, thus only 30% of capacity is used by comparison with being shipped at full capacity in flat-packs (30). Moreover, the packages and hangers imported with the garments could end up in landfill.

Usage and End-of-life Impacts

Research by the Carbon Trust (2008) has shown that the clothing usage phase can contribute more than 80% of energy used in its life cycle (31). Changing the washing temperature from 30°c to 40°c can increase energy consumption by 30%, while one load of tumble drying can produce up to 2kg of CO2 (32).

At end-of-life, an estimated 50% of the 2m tonnes of mostly imported clothing discarded yearly ends up in landfill in the UK. Some is made from non-biodegradable synthetic fibre (12), while natural fibres such as wool create the greenhouse gas methane when they decompose (33).

Unlike other industries a rapid changing in trends and product offering in the fashion industry creates further problematic impacts. Further research, by the Carbon Trust (2011), shows that the longer a garment can be worn, the less the environmental impact. If a person will wear a 250g cotton t-shirt 50 times and the t-shirt lasts one year, production accounts for 40% of CO_2 emissions, the use phase 50% and distribution, retail and disposal the other 10%. The more often a particular t-shirt is worn, however, the lower the emissions per year (higher x-axis, Figure 1) or, to put it another way, the more t-shirts required for 50 wears, the higher emission per year released (lower x-axis) (34). Thus, the longevity of a garment plays important role in average emissions per year. However, as a fast changing industry, it seems unlikely that consumers will wear the same garment 50 times in one year. Furthermore, if a garment is bought inexpensively, it is likely to be discarded as waste rather than reused or recycled (35). Clearly it is challenging to make consumers willing to trade up their clothing for better quality and longevity such that it would be valued enough to keep or recycle (30).

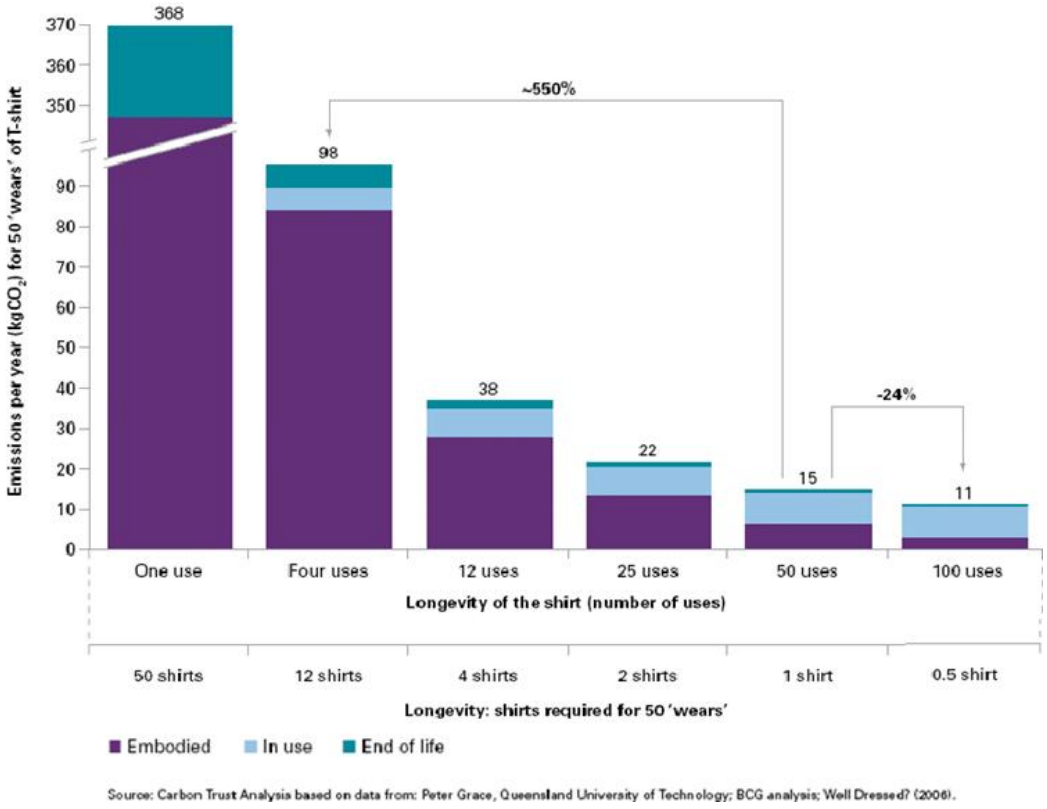

Figure 1: Emissions per year for 50 "wears" of T-shirt

Consumer Research

Previous research into consumer attitudes to, and awareness of, sustainable clothing extends back over at least ten years (Table 2). Despite this body of research and recent industry developments, a report commissioned by Defra on public understanding of sustainable clothing found that there is insufficient awareness of sustainability impacts of clothing. One reason may be that third-party labelling and certification schemes across the European Union are unclear and inconsistent. (35)

Due to the importance of price and quality in buying decisions (36), ethical issues appear to have little effect on consumer purchasing behaviours (8) and ethical fashion is not a priority when they buy clothing (37). Sustainable garments currently appear to be more expensive due to the higher cost of organic raw materials and higher wages paid to a 'fair trade' labour force (38). However, consumers do not see an environmental aspect as a value added (39) and do not want to pay a "green" price premium (40); indeed consumers associate purchasing greener products with saving money as well as energy (40). Consequently, in a highly competitive market, ethical clothing retailers may lose market share to cheaper retailers that do not seek to source sustainably (8) especially during the recession (37).

It is problematic to communicate about environmental and ethical issues to consumers, as they have not expressed enough interest in prioritising sustainability or taken action to pressurise industry to become more responsible (41). This is seen in the example of their limited knowledge of recycled clothing such as fleece jackets made from post-consumer recycled materials, which were developed as long ago as 1993 (39).

Furthermore, there is also an issue of trust in business and retailers' claims of sustainability. There are consumers who do not trust retailers' declarations of "ethical clothing' (37) perhaps due to businesses' lack of transparency (36). Such factors suggest that it is challenging to promote sustainability in the fashion supply chain without threatening future sales.

In summary, a review of the literature suggests that the public still has little awareness of what is "sustainable clothing", neither producers nor government have found a clear and consistent way to communicate to consumers why they should buy sustainable clothing, consumers do not prioritise it enough to pay a green premium, and in any case some do not trust retailers' claims of sustainability.

	Title	Research Question	Method	Finding
Nakano 2001 (39)	Perceptions Towards Clothes with Recycled Content and Environmental Awareness	Whether people know that fleece jacket are made from recycled polyester	Questionnaire, Newcastle-upon-Tyne	• Consumers will not pay over 10% more for sustainable clothes. • Environmental aspect should not be value added or more expensive. • Only 40% of people who own fleece jackets know that they are made from rPET. • Major campaign needed to raise awareness of recycled materials.
Joergens 2006 (8)	Ethical fashion: Myth or Future Trend?	Whether consumers would sacrifice their own personal need to support ethically produced clothing	Focus group, Questionnaire, UK and Germany	• Little evidence that ethical issues have any effect on consumer purchasing behaviour
Fisher, et al. 2008 (35)	Public Understanding of Sustainable Clothing	Prior understanding, introduction to 'sustainable clothing' and opportunities for change	Focus groups, Diary task, Deliberative workshops, UK	• Lack of knowledge of sustainability impacts of clothing production, use and disposal. • Third-party labelling and certification schemes across the European Union are unclear and inconsistent.
Mintel 2009 (37)	Ethical Clothing UK	How the sector is likely to develop both retailer and consumer, and whether it can move to the mainstream	Consumer research Trade research Desk research Statistical forecasting	• Ethical fashion is not a priority when consumers buy clothes. • Some consumers do not trust that "ethical clothing' is genuine.
Mintel 2009 (40)	Ethical and Green Retailing UK	How environmental issues are important for the consumer	Consumer research Trade research Desk research Statistical forecasting	• Consumers do not want to pay "green" price premium. • Recession makes people want to cut costs and purchase fewer "green" products. • Consumers only take action if it is safe.
ComRes 2010 (41)	General Environment Survey	How concerned consumers are about environmental issue	Online questionnaire	• Many consumers concerned about environmental issues. • Concern about environmental issues the same as before the recession.
Bhaduri et al. 2011 (36)	Do Transparent Business Practices Pay?	Consumer attitudes and purchase intention in relation to transparent supply chain	In-depth semi-structured Interviews	• Attitude and purchase intention. • Distrust of businesses' transparency. • Power of price and/or quality.

Table 2: The awareness and attitude of "sustainable clothing" 10 years on

METHODOLOGY

In order to capture some understanding of attitudes and awareness toward sustainability in clothing supply chain from both consumers and industry experts the literature review provided a source of information for developing primary research. The primary research has two strands, as shown in light blue arrows in Figure 2.

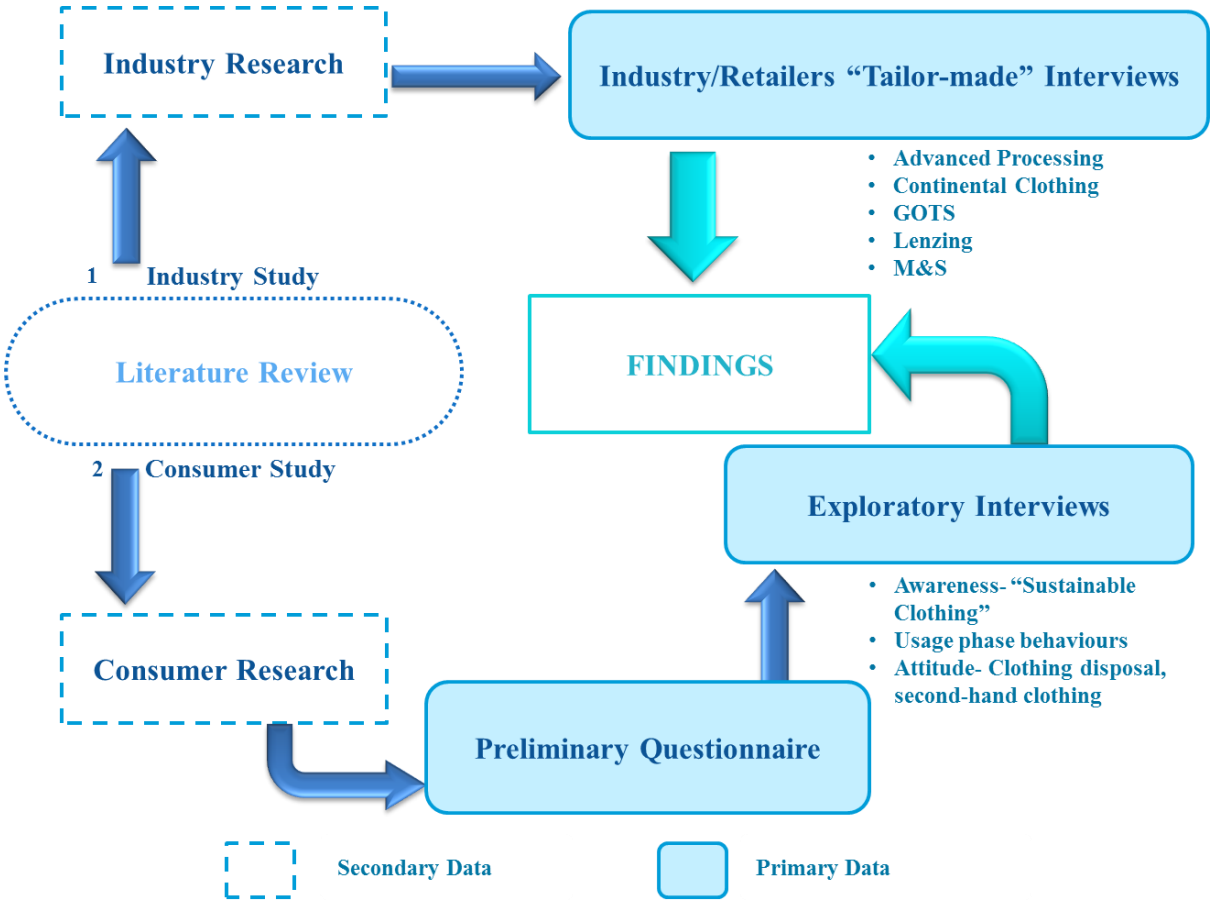

Figure 2: Methodology

Industry Research

In one strand, industry-orientated interviews were carried out with a selection of companies representing global sustainability leaders and UK retailers. These interviews aimed to identify the key sustainability questions while drawing upon available secondary information.

The industry experts, selected for first phase interviews on the basis of their sustainability initiatives and different roles in the clothing supply chain, were Advanced Processing, Continental Clothing, Global Organic Textile Standard (GOTS), Lenzing AG, and Marks & Spencer. Advanced Processing is a company which works with many UK fashion retailers in order to help the supply chain become more efficient. Continental Clothing has developed the "Earth Positive" range, which is 100% organic cotton with a 90% carbon footprint reduction, and has worked closely with the Carbon Trust to develop the first

carbon footprint label for clothing. GOTS is a working group that oversees the Global Organic Textile Standard. Lenzing AG is a world leader in man-made cellulose fibres (e.g. TENCEL® and Lenzing Modal®). Marks & Spencer is a major UK retailer and well-known for its sustainability initiative, Plan A.

The questions broadly covered the themes of the supply chain, sustainable clothing merchandising and consumer communications. They differed for each interview depending on the type of business of the interviewee and publicly available information.

Consumer Research

In the consumer strand, a preliminary questionnaire was used in order to develop questions for a subsequent series of exploratory interviews. The purpose was to examine consumer awareness of "sustainable clothing", how much consumers care about environmental impacts of clothing; and potential paths to clothing sustainability. The questions covered clothing buying behaviour, awareness of industry initiatives, use phase behaviours, and attitudes toward recycling and second-hand clothes (Table 3).

What was asked…	**To explore…**
Clothing buying behaviour	- clothing purchasing power - consumer market segment
Organic clothing buying behaviour	- awareness of "sustainable clothing" - care about environmental impacts of clothing - potential path to promote clothing sustainability
Awareness of eco-labelling	- awareness of "sustainable clothing" - potential path to promote clothing sustainability
Laundering behaviour	- how much they care about environmental impacts
Other household products disposal behaviours	- how much they care about the environment
Clothing disposal behaviours	- how much they care about environmental impacts of clothing
Attitude towards second-hand clothing	- potential path to promote clothing sustainability

Table 3: The consumer study questions and rationale

FINDINGS

There have been a series of developments both within and outside the fashion industry designed to ensure the supply chain becomes more sustainable, resulting in progress towards reducing the impacts of raw materials, processing and manufacturing, usage, and end-of-life disposal. This section presents how the research gained further knowledge by investigating clothing sector initiatives and consumer behaviour.

Reducing Raw Materials Impacts

There have been two notable developments to mitigate the environmental and social impacts of raw materials, organic cotton standards and the development of alternative sustainable fibres: man-made cellulosic fibres for cotton and recycled polyester for traditional virgin polyester.

In order to regulate and provide standards, several clothing certification schemes have been developed. These include the British Soil Association, American Organic Exchange 100, German International Association Natural Textile Industry, Japanese organic cotton association, Better Cotton Initiative, Swiss Oeko-Tex 100 and European Eco-label. In 2005, the first four of these collaborated to develop the International Working Group on Global Organic Textile Standard (GOTS). Unlike previous standards, GOTS covers not only organic farming and the hazardous or toxicity aspects of clothing but also processing from spinning, wet processing, water waste management, storage and packaging, and minimum social criteria in the workforce. In addition, GOTS-certified garments from 2014 will require that any polyester used in finishing or paper used in hang/swing tags must be post-consumer recycled materials (42). Furthermore, every part of the supply chain will need to consistently declare their activities as quality assured to maintain the certification (43), which may provide an incentive to promote supply chain transparency which is crucial for sustainability. The standard is newly developed, the latest (3.0) version being released in March 2011, and it takes time for the industry to implement the requirements and procedures on a large scale.

In order to investigate sustainable options for man-made fibre production, a senior executive from Lenzing AG was interviewed. Lenzing produces cellulose-based fibres such as Lyocell (Tencel) and Modal. The Lenzing man-made cellulose fibres (LMCs), by comparison with cotton, require no irrigated water, little agriculture land use and no pesticides or herbicides in raw material production because the cellulosic wood pulps are obtained from certified forest management to ensure environmental impacts are minimised (44). Additionally, a “cradle-to-factory gate” study has shown that LMCs production involves lower non-renewable energy use, lower GHG emissions and lower ecotoxicity than cotton production. However, it is a highly complex process involving a numbers of chemicals and a relative higher level of abiotic depletion and photochemical oxidation than cotton, though lower than that in polyester production (23). Additionally, Tencel has been shown to have a 50% higher efficiency level than cotton in water, chemicals, energy and dyestuff used in dyeing and finishing, as shown in a comparison of wash-off of unfixed dyestuff (Figure 3) (45).

Figure 3: Wash-off of unfixed dyestuff between Cotton vs. Tencel

In some cases, it is possible to recycle synthetic material into new fibre, as in the case of recycled polyester made from post-consumer recycled PET (rPET) bottles first developed by Patagonia in 1993 and most commonly used to produce fleece jackets. The production of rPET consumes at least 50% less energy, depends on the facilities, in comparison to virgin PET (46), as well as reduced waste. World-leading firms in making rPET are the Irish Wellman International (47), the Japanese Teijin fibres (48) and the Taiwanese Libolon (49). In addition, recent developments show that rPET can be made by recycling other polyester products such as recovered polyester fibre (50). Recycled PET is not only used in making fleece garments; retailers such as Marks & Spencer (51) and H&M (52) have started to use them in their main clothing range.

The consumer questionnaires and interviews indicated that consumer age and purchasing power has no relation with awareness of the term "sustainable clothing" and associated labelling. In the questionnaire, in order to test awareness of sustainable clothing, the term "organic clothing" was used. The question was "In your point of view, what is organic clothing?" This gave the common response of "organic cotton, natural fibres", hence the interview questions were later changed to "sustainable clothing". Despite the change, a diverse understanding among respondents ranged from "ethical clothing with no child labour" to "bamboo and biodegradable". In the exploratory interviews with consumers, logos were shown to interviewees (Figure 4). Consumers had no awareness of GOTS and little awareness of the Oeko-Tex 100 label; some had seen the Soil Association logo though most associated it with organic food rather than clothing.

Figure 4: sustainable clothing and its labelling

From the industry side, the UK GOTS representative remarked that certifiers choose which of the logos should be displayed on garments. A business-to-business market leader, Continental Clothing, indicated that even though their Earth Positive t-shirt has many aspects of sustainability, only one or two aspects had been chosen for promotion in marketing. Other interviewees also indicated that there has been limited communication about use of sustainable raw materials to the public and suggested that sustainability is too big for consumers to understand in a short period of time. Hence until companies are certain in what they are doing or what consumers can gain from buying sustainable clothing, they choose not to communicate with their consumers, which may explain why there is continuing confusion over the term "sustainable clothing" and why "organic" is still largely associated with non-clothing products.

Reducing Processing Impacts

There has been action at a corporate level in the fashion industry from design to end-of-life management. In design, Nike Inc. has initiated the Nike Apparel Design Tool (NADT) for free industry use, which aims to help designers to calculate sustainability scores and environment impacts throughout the life cycle (53). In retailing, companies such as Patagonia, Marks & Spencer, and Continental Clothing have worked closely with their suppliers and manufacturers to promote greener factories using renewable energy (54), lean and clean lighting and heating (55), and resource efficiency (56). Continental Clothing has also developed Earth Positive Apparel that has reduced energy and water usage by 90% as the company uses wind-generated electricity and monsoon rain irrigation (32).

Another initiative has been the development of the "Eco Index" by the Eco Working Group (EWG) formed by the Outdoor Industry Association and European Outdoor Group, although due to supply chain complexity and the range of stakeholders, it is still at the piloting stage (13). The Eco Index is a data capturing tool that enables industry to be able to score and measure where companies can improve within their supply chain. It includes six product life cycle stages (materials, packaging, product manufacturing and assemble, transport and distribution, use and service and end of life) (57) and investigates the following areas: land use intensity, water, waste, biodiversity, chemistry/toxic-people, chemistry/toxic-environment, and energy use/greenhouse gas emissions (58). The latest version (BETA Phase 2), launched early in 2011, states that it is an internal supply chain tool and not a consumer-facing label (13). The next development of the index is being undertaken by the Sustainable Apparel Coalition and will be piloted in autumn 2011 (59). It is intended for use throughout the fashion industry, not limited to the outdoor industry range of products.

More, however, needs to be done. In 2011 Greenpeace International released a report on an investigation into two dyeing complexes in China. This found that leading fashion companies such as Abercrombie and Fitch, Adidas, Calvin Klein, Converse, H&M, Lacoste, Li Ning, Nike, PVH Corp and Puma have sourced their products from Chinese suppliers responsible for water pollution by discharging toxic substances such as NP (Nonylphenol), a hormone disruptor, into natural streams. Greenpeace is requesting government and firms to adopt "zero discharge" commitments that require companies to increase their supply chain transparency and have zero discharge of hazardous chemicals by 2020. (25)

A second Greenpeace report revealed that not only has the clothing industry been polluting China but also the rest of the world. Greenpeace tested 78 clothing items which had been manufactured in 13 countries and purchased in 18 countries. NPEs (Nonylphenol ethoxylates), a chemical that degrades into NP, was found in garments from 12 of the 13 manufacturing countries and 17 of the 18 countries where items were purchased. Even though use of NPEs is banned in clothing manufacturing in EU countries, it can be released into the water supply through washing and, through fish, into the human food chain. Greenpeace's reports and a subsequent video on the Internet attracted international media attention and competition grew among leading brands to become more sustainable. Some have pledged to the "zero discharge" commitment. (60) and there is a growing pressure for the industry to become more responsible. The second report also warns: "These findings presented within this study are likely to be just the tip of the iceberg…not only limited to NPEs and NPs but a great number of hazardous substances currently used by the textile industry." (28) Such campaigning may encourage the public to become more involved in demanding sustainability in the fashion supply chain.

Reducing Usage Impacts

To reduce the energy consumption of laundering, innovation in detergents has enabled the option of washing white natural fibres at 30°c instead of conventional 'boiling' at 90°c (61). Major retailers such as M&S, Tesco, Sainsbury and Asda are a part of the Defra Clothes Cleaning Task Group which aims, through marketing and labelling, to make washing at 30°C more normal public behaviour (12). Household reactions towards the M&S Think Climate (2007) campaign (62) and Ariel Wash at 30°C (2006) campaign (63) were very positive (34) (Figure 5). These retailers are also market leaders in reducing waste by recycling and reuse of clothing packaging and hangers. For example, M&S has reported that it had saved £1m by reusing hangers (64).

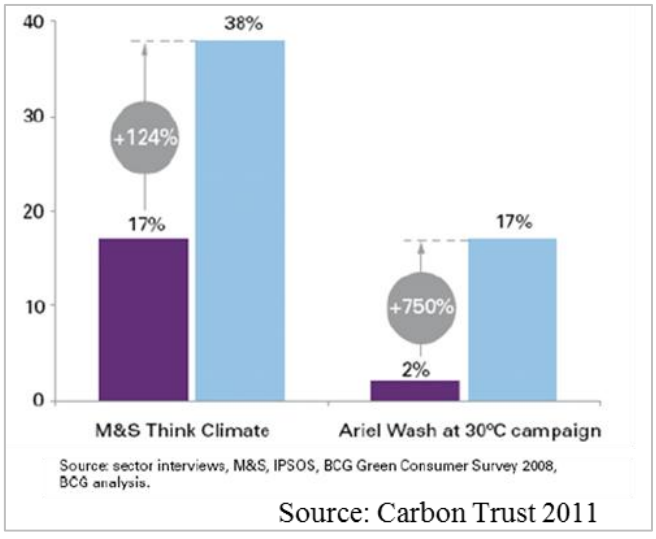

Figure 5: UK household washing below 30°C (%) - before/after campaign

The consumer study found respondents were having less of an environmental impact than previous research suggested (6). Although washing temperatures varied, tumble-drying was rarely or never used. This was because respondents lacked access to tumble dryers or considered that it took too long or used too much electricity. Line drying rather than tumble drying is not a part of the campaigns to reduce washing temperatures, but it seems to offer a potential approach to reducing clothing usage impacts further. However, the potential for "wash cool, line dry" labelling to become a global standard was criticised by industry experts who pointed to variations between countries. For example, there is only one temperature that can be used for Japanese washing machines, and no need for tumble drying in tropical countries. Personal preference, limitation of space, weather, and national culture, are important influences upon behaviour, though there might be potential for more localised promotion of certain standard practices to reduce energy consumption.

Reducing Disposal Impacts

There has been growing interest in reducing the number of garments disposed into landfill. From the industry side, Marks & Spencer has collaborated with Oxfam to create an incentive voucher scheme to encourage the public to recycle more clothing. The Salvation Army Trading Company has long been involved in collecting clothing waste and a growing number of charity and second hand clothing shops are members of the Charity Retail Association. Research into recycling clothing by Patagonia (65), Teijin (50), and Repreve (66) has found that it is problematic, as garments are blended, processed and embroidered with different types of material which are hard to separate for recycling.

In the consumer research a link between how people dispose of clothing and other household products was found. If a person recycles or reuses common household products he or she tends to do the same with clothing unless there is no textile recycle bin around. This suggests that there is a potential for reusing and recycling more used clothing but limitations exist due to external factors, such as local councils failing to provide textile recycling bins next to other bins. As far as buying second-hand clothing is concerned, the results suggested that older people have very little interest in purchasing used clothes due to the perception of cleanliness and the store experience but some younger consumers are interested. Further developments in this market are needed to attract a wider range of consumers. Some were interested in taking unwanted used clothes back to retailers in exchange for a discount on purchases. Thus there may be potential for inducing recycling and reuse behaviour while boosting brand loyalty.

CONCLUSION

In the clothing industry significant progress has been made towards increasing sustainability in recent years. This paper has shown that there is, however, an imbalance in on-going industry developments and public awareness. The industry has yet to find a way to communicate its sustainability initiatives without risking the creation of confusion, disinterest or doubt among consumers. Meanwhile consumers have not yet expressed enough interest in sustainable clothing to prioritise sustainability or taken action to pressurise the industry to

become more responsible. Nevertheless, there has been significant media interest in the past few years and research suggesting that problems are closer to consumers than they might have foreseen. Hence, there may well be a growing trend of pressuring the industry to act further to make its supply chain more sustainable. Improving sustainability-related communications with stakeholder groups, especially consumers, may be essential if businesses are to survive (67). Certification can promote common standards and correctly inform the public. Improved communication is not enough, however, and further research is necessary in order to develop a business model for the clothing industry that will support sustainable and cost-effective consumption.

ACKNOWLEDGMENTS

I would like to take this opportunity to express my gratitude to Mr Matthew Ludlam (Advanced Processing), Mr Mariusz Stochaj (Continental Clothing), Mr. Christopher Stopes (Global Organic Textile Standard), Mr Michael Kininmonth (Lenzing Fibre AG), and Dr. Mark Sumner (Marks & Spencer). Thank you all for your time and participation in my research.

REFERENCES

1. New Zealand Business Council for Sustainable Development. "New Zealand Business Council for Sustainable Development." November 2003. www.nzbcsd.org.nz/supplychain (accessed September 17, 2010).
2. Organic Exchange. "Organic Exchange- Pesticide." 2009. http://organicexchange.org/oecms/images/stories/documents/pesticides.pdf.
3. Moore, Samuel, and Larry W. Ausley. "Systems thinking and green chemistry in the textile industry: Concepts, Technologies and Benefits." *Journal of Cleaner Production* 12 (April 2004): 585-601.
4. Draper, Stephanie, Vicky Murray, and Ilka Weissbrod. "Fashioning Sustainability: A review of the sustainability impacts of the clothing industry." Forum for the Future, March 2007: 1-14.
5. Anyangwe, Eliza. "My Sustainable T-Shirt: A guide to understanding cotton production and what eco-labels mean for people and planet." London: Pesticide Action Network UK, 2010.
6. Allwood, J.M, S.E. Laursen, S.N. Russell, Malvido de Rodriguez, and N.M.P Bocken. "Well Dressed? The present and future sustainability of clothing and textile in the United Kingdom." Institute for Manufacturing, University of Cambridge, 2006.
7. Ayling, Joe. "In the money: Clothing price inflation." www.just-style.com. 28 July 2010. http://www.just-style.com/analysis/clothing-price-inflation_id108441.aspx (accessed August 31, 2010).

8. Joergens, Cartrin. “Ethical fashion: myth or future trend?” *Journal of Fashion Marketing and Management* 10, no. 3 (2006): 360-371.
9. Department for Environment Food and Rural Affairs. “Sustainable clothing roadmap briefing note.” March 2008.
10. Morley, N.J. Barlett, and I McGill. “Maximizing Reuse and Recycling of UK Clothing and Textiles.” A report to Department for Environment, Food and Rural Affairs (Oakdene Hollins Ltd), 2009: 1-32.
11. Sanfilippo, Damien. “My Sustainable T-Shirt: A guide to organic, fair trade, and other eco standards and labels for cotton textiles.” London: Pesticide Network UK, January 2007.
12. Department for Environment Food and Rural Affairs. *Sustainable Clothing Roadmap: Progress Report 2011*. London: DEFRA, 2011.
13. Eco Index. *Eco Index - About the Project*. http://www.ecoindexbeta.org/content/about-project (accessed August 2011, 22).
14. Nordås, Hildegunn Kyvik. “The Global Textile and Clothing Industry post the Agreement on Textiles and Clothing.” *World Trade Organisation Discussion Paper 5*, 2004.
15. Şen, Alper. “The US fashion industry: A supply chain review.” *International Journal of Production Economics* 114, no. 2 (August 2008): 571-593.
16. Strauss, Anselm, and Juliet Corbin. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. London: SAGE Publication, 1998.
17. Fletcher, Kate. *Sustainable Fashion & Textiles: Design Journeys*. London: Earthscan, 2008.
18. Ferrigno, Simon. “Cotton production trends and sustainability.” RITE Group. October 2010. http://www.ritegroup.org/docs/conf_2010/GlobalCotton-AdditionalInfo.pdf.
19. Pesticide Action Network UK, Environment Justice Foundation. “The deadly chemical in cotton.” http://www.ejfoundation.org/pdf/the_deadly_chemicals_in_cotton.pdf.
20. Environmental Justice Foundation. *Water and Cotton.* 2010. http://www.ejfoundation.org/page334.html.
21. Cotton Incorporated. “U.S. Cotton: Cotton market monthly economic letter.” 11 March 2011. http://www.cottoninc.com/MarketInformation/MonthlyEconomicLetter
22. Cotton Incorporated. “Summary of life cycle inventory data for cotton.” July 2009. http://cottontoday.cottoninc.com/sustainability-about/Life-Cycle-Inventory-Data-for-Cotton/Life-Cycle-Inventory-Data-for-Cotton.pdf.
23. Shen, Li, and Martin Patel. “Environmental impact assessment of man-made cellulose fibres.” *Resources, Conservation and Recycling* 55 (October 2010): 260-274.
24. Laursen, Søren Ellebæk , John Hansen, Hans Henrik Knudsen, Henrik Wenzel, Henrik Fred Larsen , and Frans Møller Kristensen. “EDIPTEX – Environmental Assessment of

Textiles." Danish Ministry of the Environment. 2007. http://www2.mst.dk/Udgiv/publications/2007/978-87-7052-515-2/pdf/978-87-7052-516-9.pdf (accessed August 10, 2011).

25. Greenpeace International. *Dirty Laundry: Unravelling the corporate connections to toxic water pollution in China*. Amsterdam: Greenpeace International, 2011.
26. New Zealand Dermatological Society Incorporated. Formaldehyde Allergy. December 2010. http://www.dermnet.org.nz/dermatitis/formaldehyde-allergy.html.
27. Formaldehyde. *Formaldehyde*. 2009. http://formaldehyde.co.tv/.
28. Greenpeace International. *Dirty Laundry 2: Hung Out to Dry- Unravelling the toxic trail from pipes to products.* Amsterdam: Greenpeace International, 2011.
29. Bureau of Labour Statistics. *Career Guide to Industries, 2010-11: Textile, Textile Product and Apparel Manufacturing*. 2011. http://www.bls.gov/oco/cg/cgs015.htm.
30. ASBCI. "*The Crude Co2st of Fashion: addressing fashion's economic and energy challenges."* ASBCI, the Forum for Clothing & Textile. Rugby, Warwickshire, 2009. 1-130.
31. Carbon Trust. *Product Carbon Footprinting: The New Business Opportunity Experience from Leading Companies.* Carbon Trust, 2008.
32. Continental Clothing. *About Earth Positive. 2011.* http://www.continentalclothing.com/page/about_earthpositive_apparel.
33. The Bureau of International Recycling. "Textiles." http://www.bir.org/industry/textiles/ (accessed August 2011)
34. Carbon Trust. *International Carbon Flows* - Clothing. 2011: The Carbon Trust, May 2011.
35. Fisher, T., Cooper, T., Woodward, S., Hiller, A. and Goworek, H. *Public Understanding of Sustainable Clothing.* Department for Environment Food and Rural Affairs, 2008.
36. Bhaduri Gargi, and Ha-Brookshire Jung E. "Do Transparent Business Practices Pay? Exploration of Transparency and Consumer Purchase Intention." *Clothing and Textiles* 29, no. 2 (2011): 135-149.
37. Mintel, Oxygen. *Ethical Clothing - UK*. Mintel International Group Limited, Feb 2009.
38. Brito, Marisa P. de, Valentina Carbone, and Corinne Meunier Blanquart. "Towards a sustainable fashion retail supply chain in Europe: Organisation and performance." *International Journal of Production Economic*s 114, no. 2 (August 2008): 534-553.
39. Nakano, Yukie. "Perceptions towards clothes with recycled content and environmental awareness: the development of end markets." In *Ecotextiles*: *The way forward for sustainable development in textiles*, by M. Miraftab and A. R. Horrocks. Boca Raton: Woodhead Publishing, 2007.
40. Mintel, Oxygen. *Ethical and Green Retailing-UK*. Mintel International Group Limited, September 2009.

41. ComRes. “General Environment Survey.” 19-21 February 2010.
42. International Working Group on Global Organic Textile Standard. “Approval Procedure and Requirements for Certification Bodies.” 25 May 2009. http://www.global-standard.org/images/gots-accreditation%20of%20cbs-issue1-25may09.pdf.
43. International Working Group on Global Organic Textile Standard. “Global Organic Textile Standard (GOTS): Version 3.0.” 1 March 2011. http://www.global-standard.org/images/stories/gots-version3_01march2011.pdf.
44. Kininmonth, Michael. “Lenzing- Back to the Future.” *Textworld- Fashion from the inside out.* Paris: Messe Frankfurt, September 2010.
45. Bartsch, Peter. “Lenzing's Approach to Sustainability in Manufacturing and Marketing Man-made Cellulose Fibres.” Frankfurt am Main: Messe Frankfurt, May 2011.
46. Patagonia. “Patagonia’s Common Threads Garment Recycling Program.” http://www.patagonia.com/pdf/en_US/common_threads_whitepaper.pdf (accessed August 23, 2011).
47. Aurelius. *Wellman International Limited.* http://www.aureliusinvest.com/investments/wellman-international-en.html (accessed August 20, 2011).
48. Teijin Fibers Limited. *Information on Materials and Other Products - Ecopet.* http://www.teijinfiber.com/english/products/specifics/ecopet.html (accessed August 20, 2011).
49. Libolon. *Libolon eco textiles: RePET and other polyester yarns.* http://www.libolon.com/eco.php (accessed August 20, 2011).
50. Teijin Fibres Limited. *Information on Materials and Other Products - Eco Circle Fibres.* http://www.teijinfiber.com/english/products/specifics/ecopet-plus.html (accessed August 20, 2011)
51. Marks & Spencer. *Marks & Spencer - Greener Living.* http://www.marksandspencer.com/Recycled-Polyester-Greener-Living/b/63130031 (accessed August 20, 2011).
52. Hennes & Mauritz. *H&M - Corporate Responsibility*. (accessed August 20, 2011).
53. NIKE. “Corporate Responsibility Report: FY 07 08 09.” 2009. http://www.nikebiz.com/crreport/content/pdf/documents/en-US/full-report.pdf.
54. Continental Clothing. “Case examples from the sustainable clothing action plan.” London, 2010.
55. Marks & Spencer. “Sustainable Construction Manual.” London, 2010.
56. Patagonia USA. *Environmentalism: What Makes a Building Green?* 2011. http://www.patagonia.com/us/patagonia.go?assetid=12080.
57. Eco Index. *Eco Index - Eco Framework*. http://www.ecoindexbeta.org/content/eco-framework (accessed August 2011, 22).

58. Eco Index. *Eco Index - Lifecycle Stages*. http://www.ecoindexbeta.org/content/lifecycle-stages (accessed August 22, 2011).
59. Ecotextile. "Dates Set for Eco-Index Apparel Tool." *Ecotextile,* 18 August 2011.
60. Greenpeace International. *Detox hat-trick: Adidas joins Nike and Puma in ditching toxic chemicals.* http://www.greenpeace.org.uk/blog/toxics/detox-hat-trick-adidas-joins-nike-and-puma-20110831 (accessed August 31, 2011).
61. Procter & Gamble. "Comparative Life Cycle Assessment (LCA) of Ariel "Actif à froid" (2006), with previous Ariel laundry detergents (2001)." 2006.
62. Marks & Spencer. *Think Climate- wash your clothes at 30°C.* http://plana.marksandspencer.com/we-are-doing/climate-change/stories/35/ (accessed August 2011, 2011).
63. Procter & Gamble. Procter & Gamble - Ariel Turn to 30. http://www.bitc.org.uk/resources/case_studies/pg_rm.html (accessed August 20, 2011).
64. Marks & Spencer. "M&S Reports on Plan A Progress in 2010/11." http://corporate.marksandspencer.com/page.aspx?pointerid=ec1319321f3040aca17d8bd341211872 (accessed August 23, 2011).
65. Patagonia. *Fabrics: Recycled Polyester.* http://www.patagonia.com/us/patagonia.go?assetid=2791 (accessed August 22, 2011).
66. Repreve. Repreve - *A unique recycle fibre.* http://www.repreve.com/WhatIsRepreve/AUniqueRecycledProduct.aspx (accessed August 22, 2011).
67. MIT Sloan Management Review. *The Business of Sustainability- Findings and Insights from the First Annual Business of Sustainability Survey and the Global Thought Leaders' Research Project.* Massachusetts: Massachusetts Institute of Technology, 2009.